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Chordal cutting technique through aortotomy to treat chronic ischemic mitral regurgitation: Surgical technique

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ABSTRACT

Objective: To describe original surgical treatment in patients with ischemic mitral valve regurgitation due to tenting phenomenon.

Background: The optimal surgical treatment of ischemic mitral regurgitation (MR) in patients with coronary artery disease is controversial. The standard treatment is revascularization and reduction annuloplasty. We describe the first clinical application of an original technique to treat MR, through aortotomy. The chordal cutting technique was described first in experimental studies by Messas et al.

Methods: The procedure consisted in cutting the 2 strut chordae of the anterior mitral valve through a small aortotomy, using a brief conventional cardiopulmonary bypass. All the cases were controlled at the end of the procedure by transesophageal echocardiography (TEE).

Results: Five patients were treated using this technique; the procedure was brief, effective and safe in all the patients. TEE showed no mitral regurgitation. No preoperative morbidity or mortality occurred and post-operative course was uneventful.

Conclusion: Chordal cutting technique through aortotomy is a safe and effective technique that should be considered to treat severe ischemic mitral regurgitation due to tenting phenomenon.

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1. Introduction

The optimal surgical treatment of severe ischemic mitral regurgitation associated with coronary artery disease is controversial. Chronic ischemic mitral regurgitation usually occurs as a result of a complex lesion to repair. The standard treatment is myocardial revascularisation and reduction annuloplasty. The purpose of our work is to describe an original chordal cutting technique through aortotomy for mitral valve repair attempted successfully in 5 patients with ischemic cardiomyopathy and severe mitral regurgitation.

Chronic ischemic mitral regurgitation usually occurs as a result of a complex lesion to repair. The standard treatment for functional ischemic mitral regurgitation (MR) is revascularisation and reduction annuloplasty; however, the results are suboptimal in certain subgroups of patients. Although the immediate results are excellent, some patients develop recurrent MR at variable time points following surgery. Ischemic MR might improve following myocardial revascularisation independently of the degree of its preoperative severity. Therefore, it has been advised not to attempt repair at the primary operation, except in patients with obvious organic valvular lesions.

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We describe the first use of an original technique, through aortotomy, to treat ischemic MR due to a tenting mechanism. This mechanism has originally been described by Mesas and associates in an experimental animal study.^{1,2} We have taken this technique, modified it and tried it for the first time in humans.

2. Methods

2.1. General anatomy of the mitral valve and surgical technique

The valvular complex comprises the annulus, the leaflets, the tendinous cords, and the papillary muscles. The mitral valve is obliquely located in the heart and adjacent to the aortic valve.³

It is the anterior leaflet that is in fibrous continuity with the aortic valve. The anterior leaflet hangs like a curtain between the left ventricular inflow and outflow tracts.

The tendinous cords of the mitral valve are attached to 2 groups of papillary muscles or directly to the postero-inferior ventricular wall to form the tensor apparatus of the valve. Cords that arise from the apices of the papillary muscles attach to both anterior and posterior leaflets of the valve. There are numerous classifications of tendinous cords. One of the earlier classifications is cited in 'Quain's elements of anatomy'.⁴ This classification distinguishes 3 orders of tendinous cord according to the site of attachment to the leaflets. The first order cords are those inserted on the free edge. They are numerous, delicate, and often form networks near the edge. Second order cords insert on the ventricular surface of the leaflets beyond the free edge, forming the rough zone. These are thicker

than first order cords. Third order cords attach only to the posterior leaflet since they arise directly from the ventricular wall or from small trabeculations. Rough zone cords in the posterior leaflet are generally shorter and thinner than those found in the anterior leaflet. Among the rough zone cords of the anterior leaflet are 2 that are the largest and thickest (Figs. 1 and 2). Termed strut cords, these arise from the tip of each papillary muscle and are thought to be the strongest.⁵ The strut cords and parts of the rough zone correspond to second order cords. Basal cords are unique to the posterior leaflet.³

Alterations in the size and shape of the left ventricle wall can distort the locations of the papillary muscles, resulting in valvular function disturbance.⁶

Chordal cutting technique consists in cutting the 2 strut chordae attached to the center of the anterior leaflet. Through a conventional aortotomy, the anterior mitral leaflet was everted through the aortic annulus, and the 2 most centrally attaching strut chordae were cut (Figs. 1 and 3).

3. Results

Five consecutive patients, having similar preoperative clinical profile, were operated using this technique. Coronary artery bypass grafting was achieved in 4 patients. Operation was conducted through median sternotomy. Moderate hypothermic (33 °C) cardiopulmonary bypass and antegrade cold blood cardioplegia were used. The chordal cutting procedure was brief; the procedure was achieved through a small conventional transverse aortotomy (3 cm incision nearly 5 cm above the right coronary artery) with a mean cardiopulmonary bypass of 15 min. All the patients had transesophageal echocardiography control at the end of the procedure, showing no MR

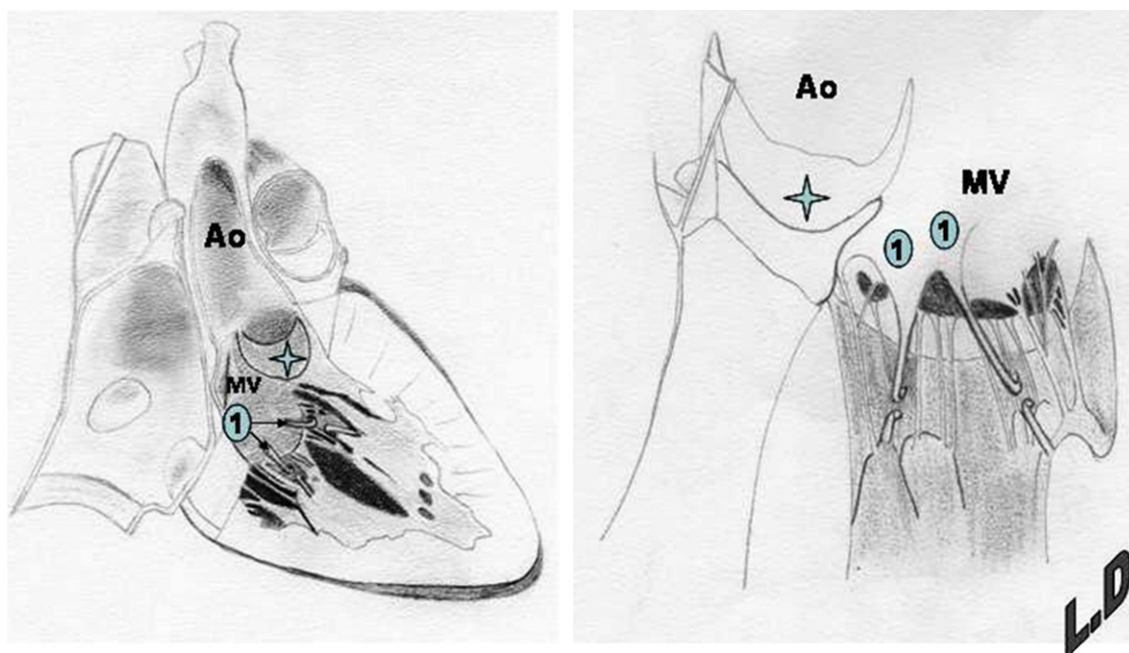


Fig. 1 – Drawing view of chordal cutting procedure through aortotomy showing the 2 cut chordae (1). Mitral valve (MV) has re-expanded. Ao: aorta. The stars indicate the aortic leaflets.

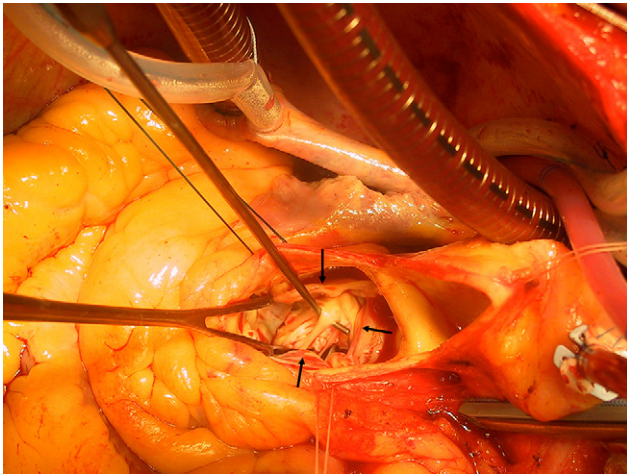


Fig. 2 – Operative view through the aortotomy showing clearly the stick chordae before chordal cutting procedure. The arrows indicate the aortic leaflets.

with normal mitral valve leaflets movement and confirming the efficacy of the procedure. The post-operative course was uneventful and all the patients were discharged from the hospital within 12 days.

4. Discussion

This technique was suggested by Messas and associates, based on experimental studies in a sheep model of chronic ischemic MR using 3-dimensional and Doppler echocardiography to quantify MR and related to 3-dimensional changes in valve configuration.^{1,2} In contrast with that technique described by Messas and associates,^{1,2} we used an aortotomy instead of the conventional left atriotomy allowing comfortable access to the anterior mitral valve leaflet (Figs. 1–3). This has the advantage of avoiding the left atriotomy which is usually of small size in ischemic MR and thus difficulty in exposing

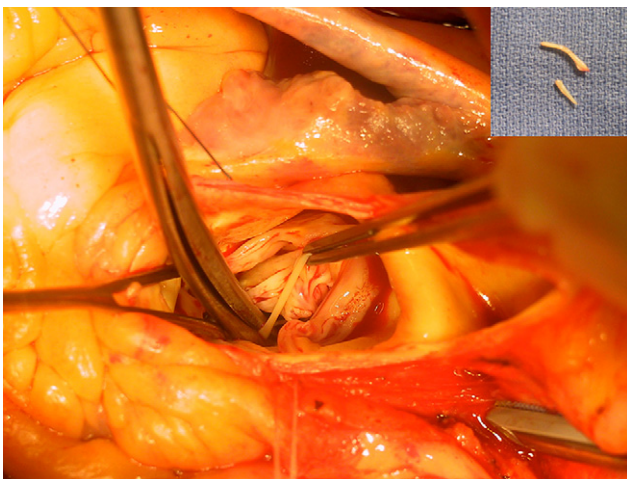


Fig. 3 – Operative view, after chordal cutting achievement, through aortotomy showing the 2 cut chordae.

enough the mitral valve. After infarction, the papillary muscles are displaced laterally, apically and posteriorly, pulling the leaflet into the left ventricle (LV). Distortion is prominent in the basal anterior leaflet, creating a bend. Cutting these strut chordae can eliminate this bend, improve coaptation, and reduce MR.¹ Although the benefit of mitral surgery in comparison with myocardial revascularization is difficult to evaluate in acute IMR, the current opinion is that, in most cases, the main cause of IMR is tethering of the leaflet secondary to left ventricular dilatation and papillary muscles dysfunction. In ischemic hearts, if MR can be reduced, the dominant effect of ventricular decompression may be increased contractile function due to reduced wall stress. For those reasons, we could consider that chordal cutting is an effective procedure to treat IMR.

Strut chordal cutting eliminated the angulation of the anterior leaflet, which assumed a more relaxed configuration closer to the annulus, with its distal marginal bending to coapt with the posterior leaflet. The intact marginal chordae continue to prevent leaflet prolapse or fail and can, theoretically, continue to maintain left ventricular function through chordal continuity as a benefit of valve repair as opposed to replacement.^{7,8} In our technique only 2 strut chordae were cut, preserving intact valvulo-ventricular continuity. Ischemic mitral regurgitation (IMR) is always preceded by a myocardial infarction (MI) and is an important cause of cardiac morbidity and mortality after MI. The multiplication of surgical treatment options offered in case of IMR clearly shows that it is still a difficult and highly debated subject that is far from being closed. The factors involved in the post-operative regression of IMR are too complex and numerous to be attached to a given procedure.

5. Conclusion

Ischemic MR should be diagnosed promptly and carefully evaluated in patients with ischemic cardiomyopathy. Furthermore, chordal cutting through aortotomy in case of anterior leaflet tenting is an effective surgical option for mitral valve repair. The long-term clinical outcome of such technique needs to be evaluated in large clinical trials.

Conflict of interest

The authors have no conflict of interest.

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Ethical approval

None declared.

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Supplementary material

Supplementary material can be found, in the online version, at doi: [10.1016/j.ijssu.2007.09.004](https://doi.org/10.1016/j.ijssu.2007.09.004).

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